CLAIMS:

1. A method for determining RGB filter set and color estimation performance for RGB LED color sensing, the method comprising:

constructing a criteria function describing an error between desired color matching functions and a spectral response of an RGB filter set;

determining RGB filter set response characteristics based on the criteria function; and

determining color estimation parameters for substantially optimal color estimation with the RGB filter set based upon the determined RGB filter set response characteristics.

2. The method of claim 1 wherein determining the RGB filter response characteristics comprises evaluating the criteria function to determine the RGB filter response characteristics resulting in a minimum value of a constraint set criteria function.

3. The method of claim 2 wherein the criteria function is represented by the equation:

$$J_{M,n} = \int_{\sigma} \left| \begin{bmatrix} R_{LED}(\lambda) & 0 & 0 \\ 0 & G_{LED}(\lambda) & 0 \\ 0 & 0 & B_{LED}(\lambda) \end{bmatrix} \begin{bmatrix} \overline{xmc}(\lambda) \\ \overline{ymc}(\lambda) \\ \overline{zmc}(\lambda) \end{bmatrix} - M \begin{bmatrix} r(\lambda) \\ g(\lambda) \\ b(\lambda) \end{bmatrix} - n \right| d\lambda$$

wherein $r(\lambda)$, $g(\lambda)$ and $b(\lambda)$ are positive real continuous sensitivity functions of the RGB filter set wherein $\lambda \in \sigma = [380, 780]$ nm and wherein $R_{LED}(\lambda)$, $G_{LED}(\lambda)$ and $B_{LED}(\lambda)$ are the spectra of red, green and blue LED light sources and wherein $\overline{xmc}(\lambda), \overline{ymc}(\lambda), and\ \overline{zmc}(\lambda)$ are a set of color matching functions and wherein M is a 3x3 constant matrix and n is a 3x1 constant vector.

4. The method of claim 3 further comprising:

constructing spectral approximation functions $\hat{x}$, $\hat{y}$, and $\hat{z}$ for the RGB LED light sources from the M and n determined by evaluating the criteria function.

5. The method of claim 4 wherein the spectral approximation functions are represented by the equation:

$$\begin{bmatrix}\hat{x}\\ \hat{y}\\ \hat{z}\end{bmatrix} = (M\begin{bmatrix}r(\lambda)\\ g(\lambda)\\ b(\lambda)\end{bmatrix} + n) * u\{M\begin{bmatrix}r(\lambda)\\ g(\lambda)\\ b(\lambda)\end{bmatrix} + n\}$$ and wherein u is a step function.

6. The method of claim 5 further comprising:

determining estimated tristimulus values for the RGB LED light sources based upon the spectral approximation functions.

7. The method of claim 6 wherein the estimated tristimulus values $\hat{X}, \hat{Y}, \hat{Z}$ are determined according to the relationship represented by the equation:

$$\begin{bmatrix}\hat{X}\\ \hat{Y}\\ \hat{Z}\end{bmatrix} = \int_{\sigma}\begin{bmatrix}\hat{x}(\lambda)\\ \hat{y}(\lambda)\\ \hat{z}(\lambda)\end{bmatrix}P(\lambda)d\lambda$$ wherein $P(\lambda) = R_{LED}(\lambda) + G_{LED}(\lambda) + B_{LED}(\lambda)$.

8. The method of claim 7 further comprising:

implementing a color sensing color calibration through the function represented by the equation:

$$\begin{bmatrix}X\\ Y\\ Z\end{bmatrix} = M_{cal}Mc^{-1}\begin{bmatrix}\hat{X}\\ \hat{Y}\\ \hat{Z}\end{bmatrix}$$ wherein X, Y *and* Z are tristimulus functions of the RGB LED illuminants and wherein M_{cal} is a calibration matrix and wherein Mc^{-1} is an inverse MacAdam's matrix.

9. A computer readable medium storing a computer program comprising:

computer readable code for constructing a criteria function describing an error between desired color matching functions and a spectral response of an RGB filter set;

computer readable code for determining RGB filter set response characteristics based on the criteria function; and

computer readable code for determining color estimation parameters for substantially optimal color estimation with the RGB filter set based upon the determined RGB filter set response characteristics.

10. The computer readable medium of claim 9 wherein determining the RGB filter response characteristics comprises evaluating the criteria function to determine the RGB filter response characteristics resulting in a minimum value of a constraint set criteria function.

11. The computer readable medium of claim 10 wherein the criteria function is represented by the equation:

$$J_{M,n} = \int_{\sigma} \left| \begin{bmatrix} R_{LED}(\lambda) & 0 & 0 \\ 0 & G_{LED}(\lambda) & 0 \\ 0 & 0 & B_{LED}(\lambda) \end{bmatrix} \begin{bmatrix} \overline{xmc}(\lambda) \\ \overline{ymc}(\lambda) \\ \overline{zmc}(\lambda) \end{bmatrix} - M \begin{bmatrix} r(\lambda) \\ g(\lambda) \\ b(\lambda) \end{bmatrix} - n \right| d\lambda$$

wherein $r(\lambda)$, $g(\lambda)$ and $b(\lambda)$ are positive real continuous sensitivity functions of the RGB filter set wherein $\lambda \in \sigma = [380, 780]$ nm and wherein $R_{LED}(\lambda)$, $G_{LED}(\lambda)$ and $B_{LED}(\lambda)$ are the spectra of red, green and blue LED light sources and wherein $\overline{xmc}(\lambda), \overline{ymc}(\lambda), and\ \overline{zmc}(\lambda)$ are a set of color matching functions and wherein M is a 3x3 constant matrix and n is a 3x1 constant vector.

12. The computer readable medium of claim 11 further comprising:

computer readable code for constructing spectral approximation functions $\hat{x}$, $\hat{y}$, and $\hat{z}$ for the RGB LED light sources from the M and n determined by evaluating the criteria function for the RGB filter set.

13. The computer readable medium of claim 12 wherein the spectral approximation function equation is:

$$\begin{bmatrix} \hat{x} \\ \hat{y} \\ \hat{z} \end{bmatrix} = (M \begin{bmatrix} r(\lambda) \\ g(\lambda) \\ b(\lambda) \end{bmatrix} + n) * u\{M \begin{bmatrix} r(\lambda) \\ g(\lambda) \\ b(\lambda) \end{bmatrix} + n\}$$ wherein u is a step function.

14. The computer readable medium of claim 13 further comprising:

computer readable code for determining estimated tristimulus values for the RGB LED light sources based upon the spectral approximation functions.

15. The computer readable medium of claim 14 wherein the estimated tristimulus values $\hat{X}, \hat{Y}, \hat{Z}$ are determined according to the relationship represented by the equation:

$$\begin{bmatrix} \hat{X} \\ \hat{Y} \\ \hat{Z} \end{bmatrix} = \int_{\sigma} \begin{bmatrix} \hat{x}(\lambda) \\ \hat{y}(\lambda) \\ \hat{z}(\lambda) \end{bmatrix} P(\lambda) d\lambda \text{ wherein } P(\lambda) = R_{LED}(\lambda) + G_{LED}(\lambda) + B_{LED}(\lambda).$$

16. The computer readable medium of claim 15 further comprising:

computer readable code for implementing a color sensing color calibration through the function represented by the equation:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = M_{cal} Mc^{-1} \begin{bmatrix} \hat{X} \\ \hat{Y} \\ \hat{Z} \end{bmatrix}$$ wherein *X, Y and Z* are tristimulus functions of the RGB LED illuminants and wherein M_{cal} is a calibration matrix and wherein Mc^{-1} is an inverse MacAdam's matrix.

17. A system for determining RGB filter set and color estimation performance for RGB LED color sensing comprising:

means for constructing a criteria function describing an error between desired color matching functions and a spectral response of an RGB filter set;

means for determining RGB filter set response characteristics based on the criteria function; and

means for determining color estimation parameters for substantially optimal color estimation with the RGB filter set based upon the determined RGB filter set response characteristics.

18. The system of claim 17 further comprising:

means for constructing spectral approximation functions $\hat{x}, \hat{y}$, and $\hat{z}$ for the RGB LED light sources from the *M* and *n* determined by evaluating the criteria function.

19. The system of claim 18 further comprising:

means for determining estimated tristimulus values for the RGB LED light sources based upon the spectral approximation functions.

20. The system of claim 19 further comprising:

means for implementing a color sensing color calibration through the function represented by the equation:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = M_{cal} Mc^{-1} \begin{bmatrix} \hat{X} \\ \hat{Y} \\ \hat{Z} \end{bmatrix}$$ wherein *X, Y and Z* are tristimulus functions of the RGB LED illuminants and wherein M_{cal} is a calibration matrix and wherein Mc^{-1} is an inverse MacAdam's matrix.